

AZ-SMART

ARIZONA'S SOCIOECONOMIC MODELING, ANALYSIS & REPORTING TOOL BOX

COUNCIL FOR TECHNICAL SOLUTIONS
MAY 18, 2010



AZ-SMART

- ❑ Modeling at MAG
- ❑ What & why AZ-SMART?
- ❑ Model systems - UrbanSim
- ❑ Model types and templates - UrbanSim
- ❑ Data requirements
- ❑ Model system sequence
- ❑ Current status



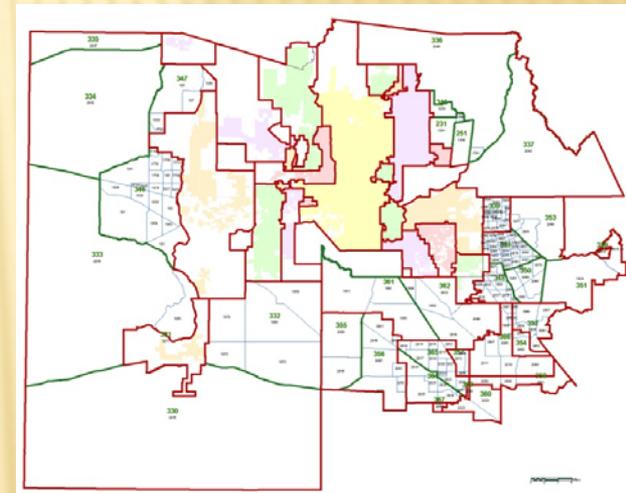
MODELING @ MAG

- ❑ Have been producing official sub-regional projections
 - ❑ Since the last 30+ years
 - ❑ Last set in July 2007
 - ❑ Prepared every 5 years or as needed
 - ❑ Based on official county control totals

- ❑ MAG 2007 Geographies
 - Municipal Planning Area (MPA) **28**
 - Regional Analysis Zone (RAZ) **148**
 - Socioeconomic Analysis Zone (SAZ) **1955**

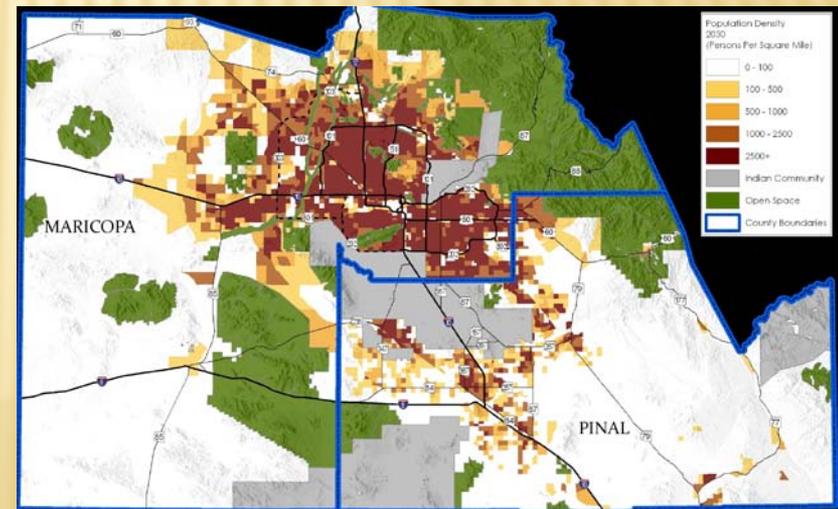
- ❑ MAG Approval Process
 - ❑ POPTAC
 - ❑ Management Committee
 - ❑ Regional Council

- ❑ 40+ variables projected
 - ❑ Housing units, households, population in households and group quarters
 - ❑ Employment by 5 land use and 2 other categories
 - ❑ Additional variables like seasonal, transient population, etc.

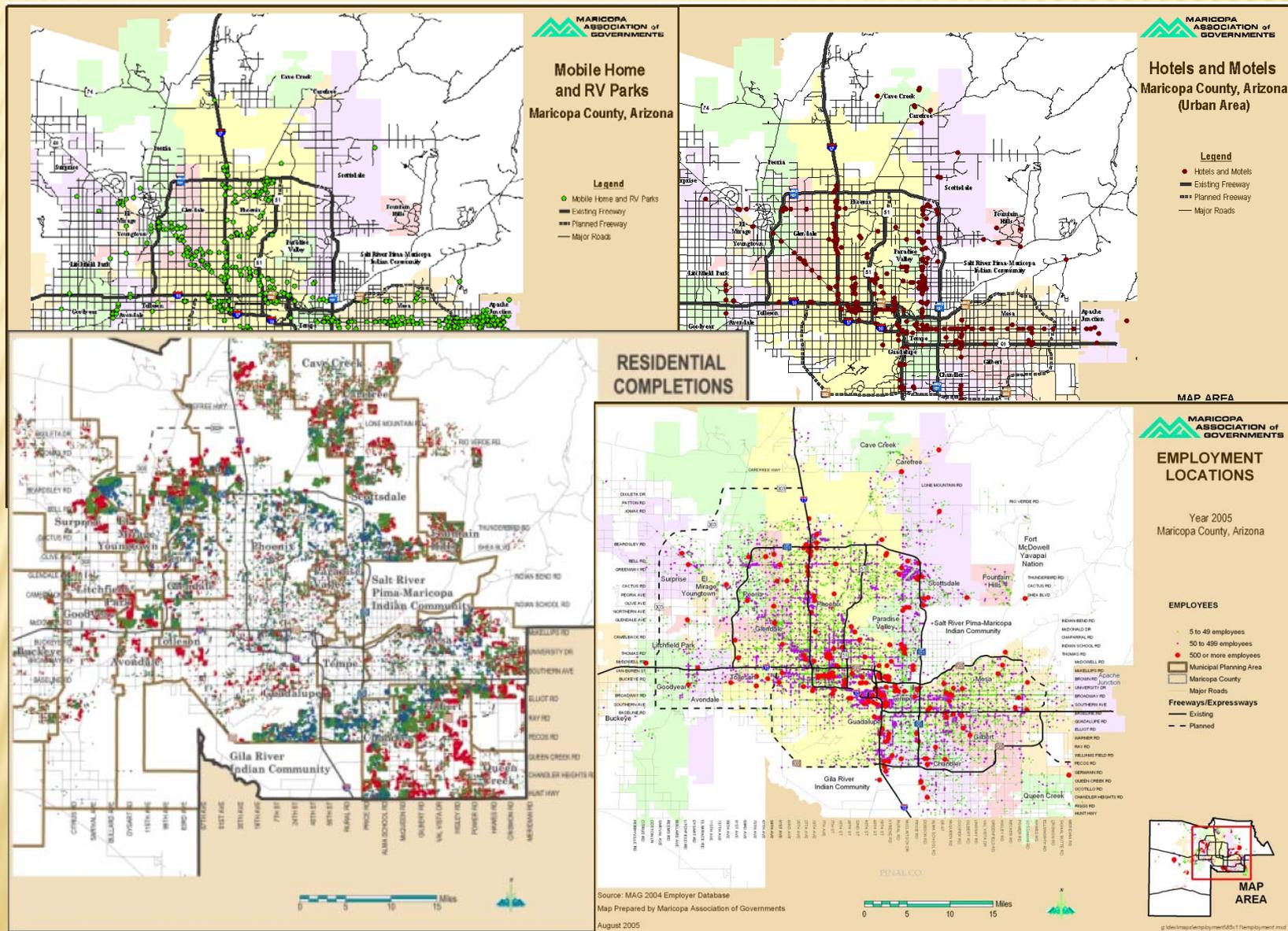


MODELING @ MAG

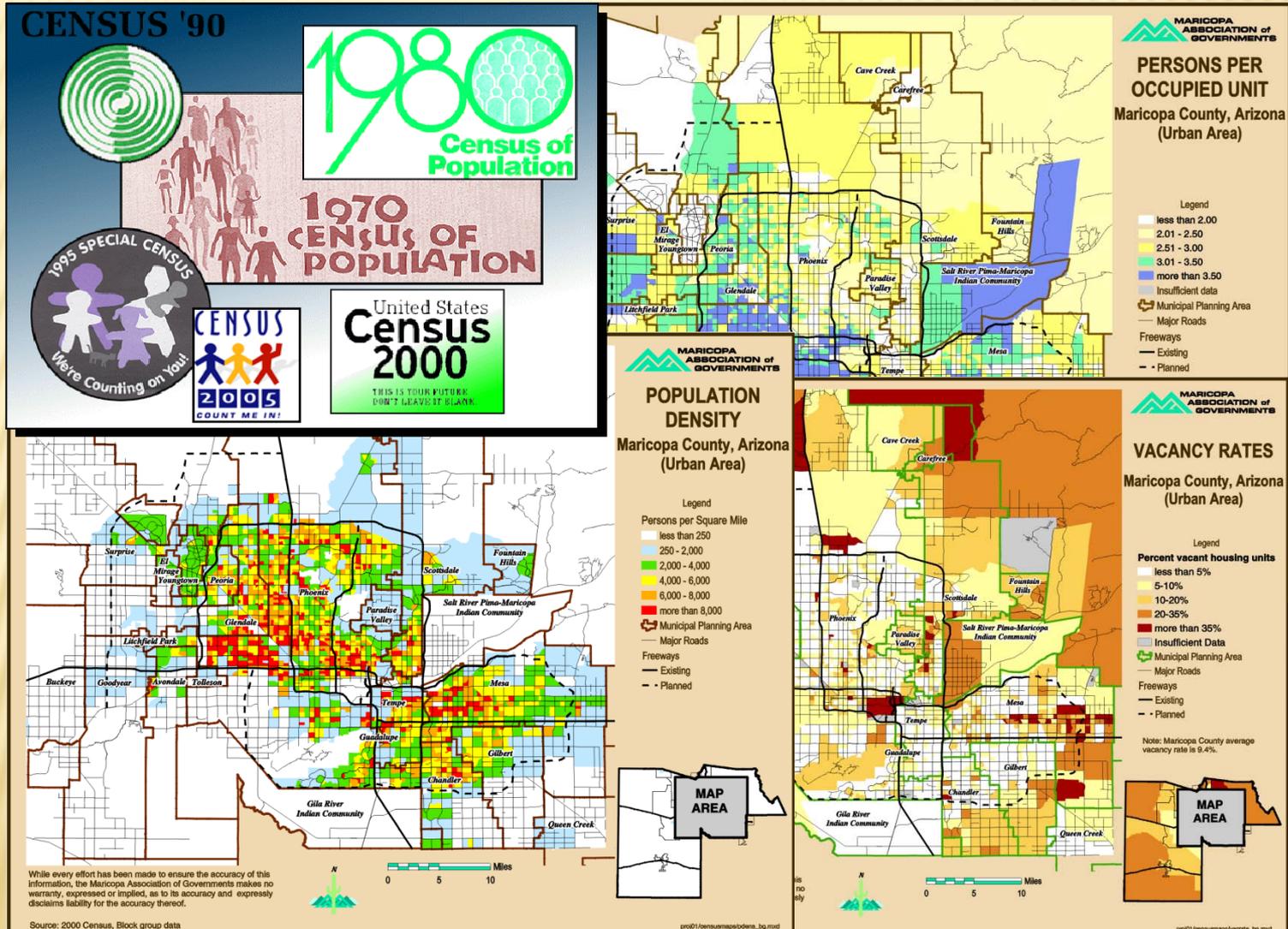
- ❑ Transportation infrastructure in Maricopa County impacted by growth in Pinal County
- ❑ 2003: developed placeholder projections for large part of Pinal County (extending to Eloy)
 - ❑ 9 MPAs, 24 RAZs, 136 SAZs
- ❑ CAAG Projections – MAG models being used to develop projections by TAZ for Pinal County using market area projections adopted by CAAG.



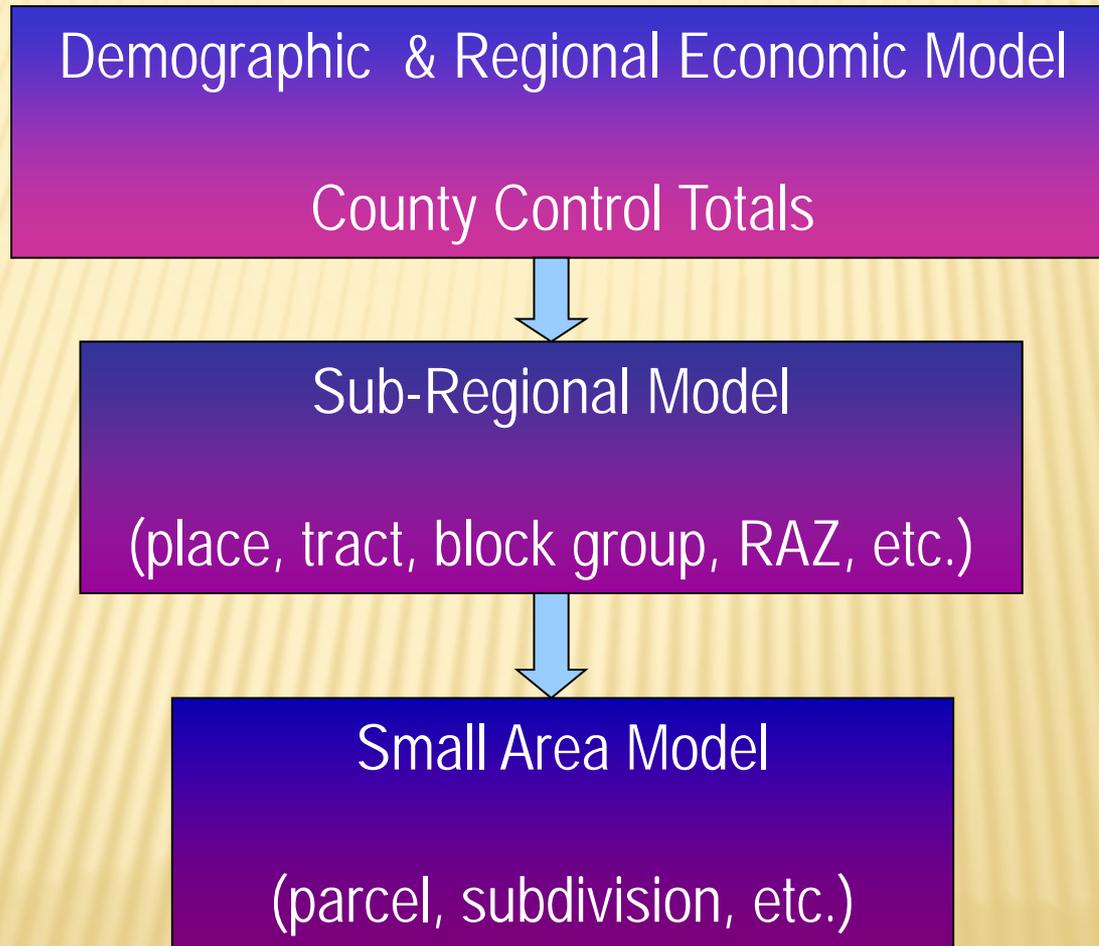
DATA COLLECTION: LOCATIONAL INFORMATION



REVIEW & CONSISTENCY WITH LATEST CENSUS



MODELING PROCESS



AZ-SMARTWHAT?

- ❑ Framework for developing socioeconomic projections
- ❑ Applications to develop & maintain
 - ❑ Land use and other socioeconomic data
 - ❑ Models
 - ❑ Scenarios and Analysis
- ❑ Tools that are flexible
 - ❑ Work at any geography
 - ❑ Add/remove /change models and variables



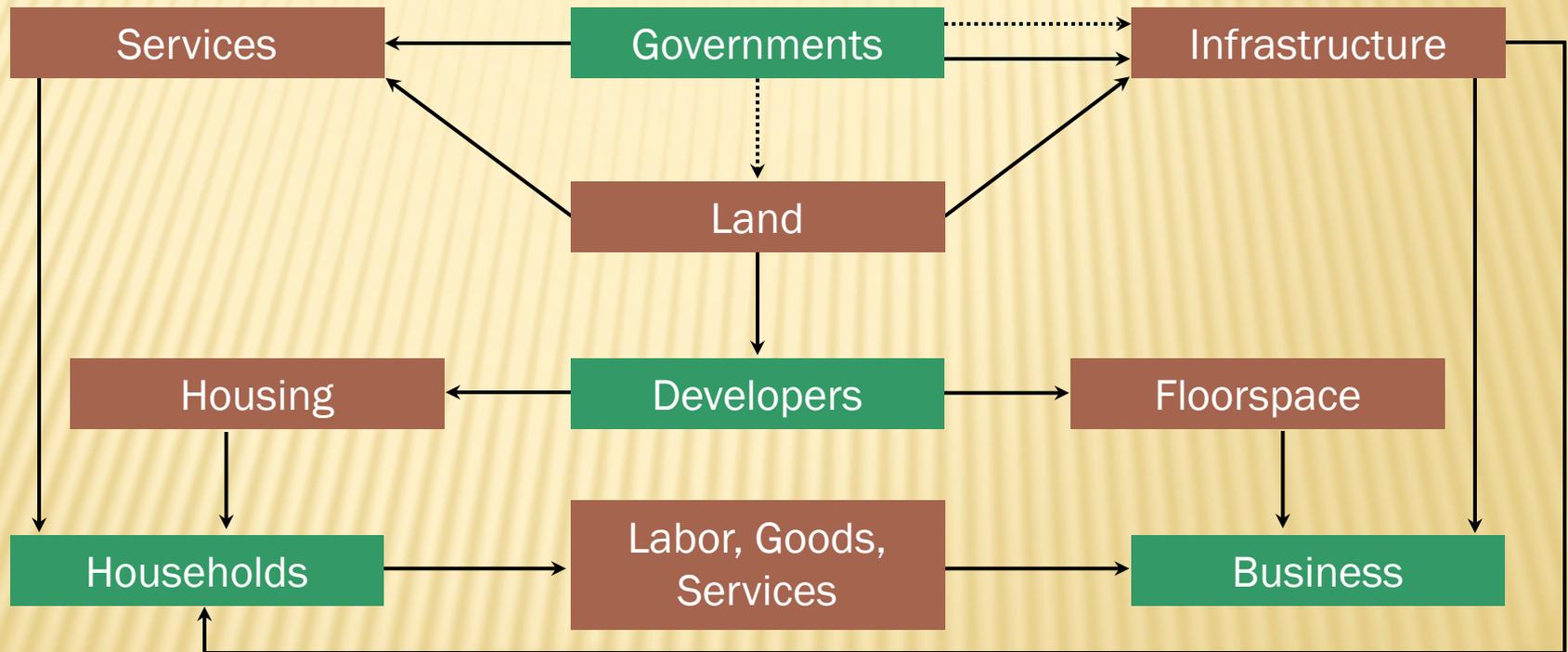
WHY AZ-SMART?

- ❑ Current platform
 - ❑ Old technology
 - ❑ New questions
- ❑ Arizona 2050 growth scenario
 - ❑ Expand model system beyond Maricopa County
 - ❑ Incorporate data of varying resolution and detail
- ❑ Current buzzwords
 - ❑ Agent based modeling
 - ❑ Behavioral models
 - ❑ Activity models
- ❑ Built on OPUS Platform using UrbanSim
 - ❑ Emerging National Standard
 - ❑ Funded by EPA/NSF/FHWA
 - ❑ Developed by Paul Waddell @ University of Washington
 - ❑ Similar to MAG's previous small area model (SAM-IM)



URBANSIM

- ❑ Current modeling engine behind AZ-SMART
- ❑ Market driven model that incorporates interactions between land use, transportation, and public policy.



—————> Flow of consumption from supplier to consumer.

.....> Regulation or pricing.



AZ-SMART

MODEL SYSTEMS



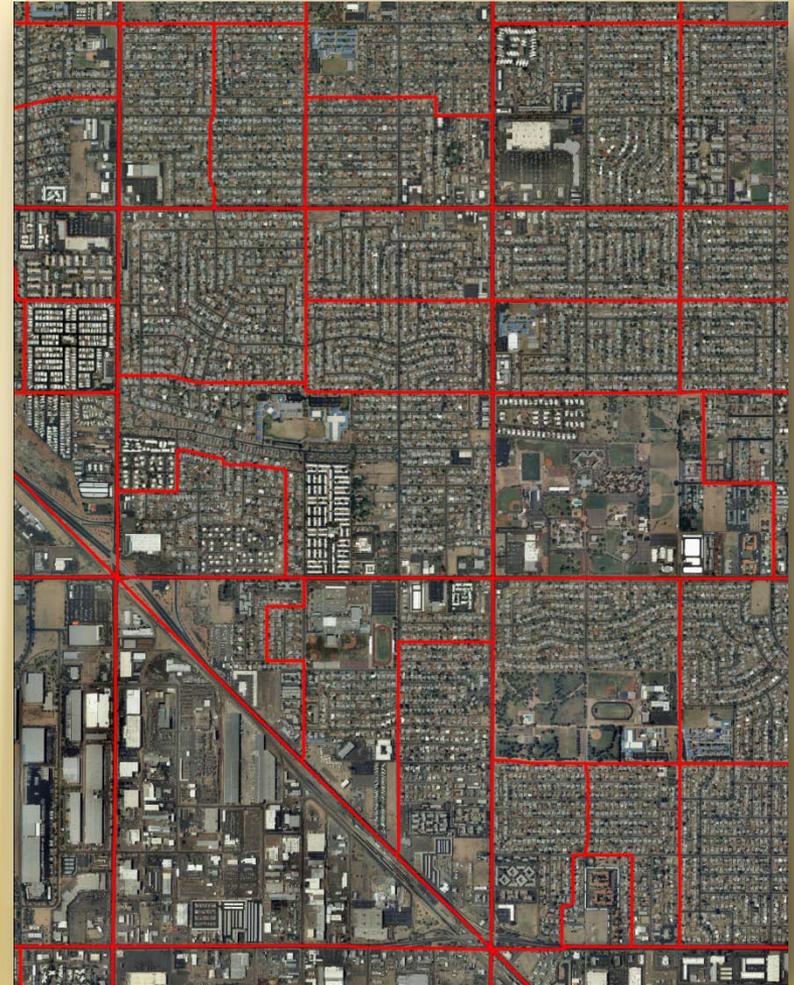
AZ-SMART MODEL SYSTEMS

- ❑ **Zone, Parcel, or Gridcell based**
- ❑ **Disaggregate, decision making agents:**
 - ❑ Individual households and/or persons
 - ❑ Individual businesses and/or jobs
- ❑ **Incorporate accessibility measures**
- ❑ **Ability to integrate policy constraints:**
 - ❑ General plan
 - ❑ Environmental factors etc.
- ❑ **Systems vary on:**
 - ❑ Levels of land and built-space aggregation
 - ❑ Data requirements
 - ❑ Real Estate Development models



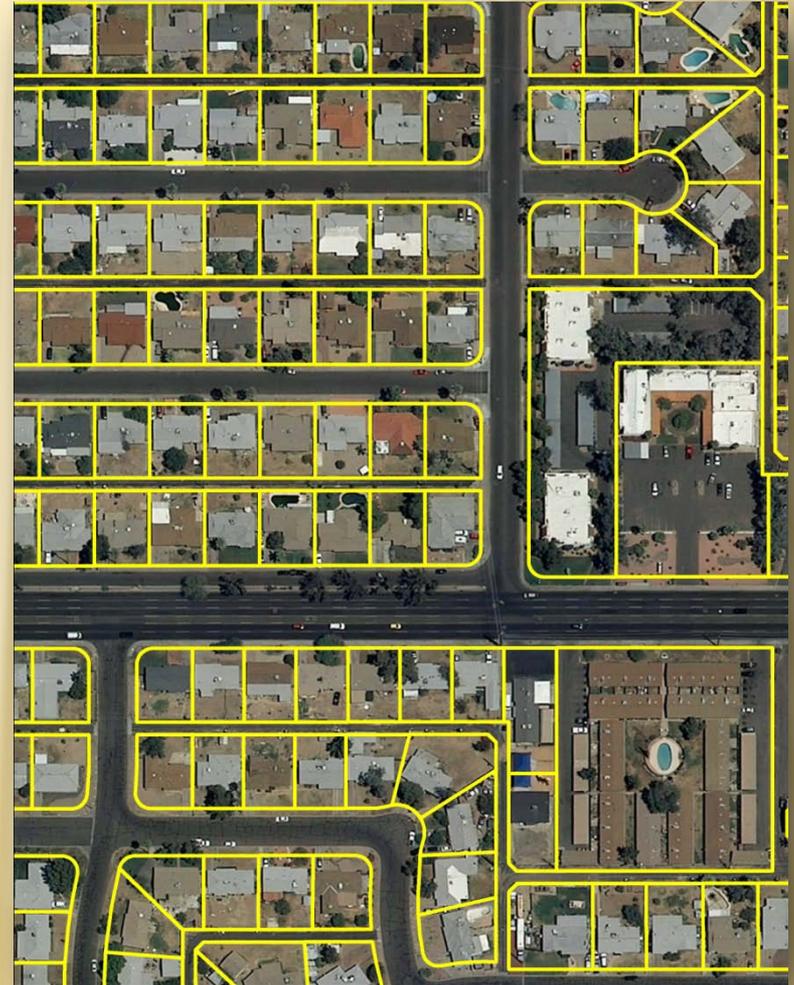
ZONE BASED MODEL SYSTEM

- ❑ Boundaries are arbitrary, can match Place, Tract, Block group, TAZs, etc.
- ❑ Data requirements are lower, most data may be synthesized from readily available sources
- ❑ Aggregate in nature – land use constraints incorporated as capacity
- ❑ Being implemented at MAG as sub-regional model



PARCEL BASED MODEL SYSTEM

- ❑ Utilizes parcel boundaries – easily understandable
- ❑ Detailed representation of built environment and its characteristics
- ❑ Aggregated to other geographies as needed
- ❑ Spatial link to special populations – prisons, seasonal, transient, etc.
- ❑ Being implemented at MAG as the small area model



GRIDCELL-BASED MODEL SYSTEM

- ❑ Gridcells are arbitrary in size
- ❑ Data requirements are similar to parcel model – not as onerous
- ❑ Aggregation of data may present problems
- ❑ Currently used in academic/research exercises



AZ-SMART

MODEL TYPES



AZ-SMART MODEL TYPES

- System needs to address different urban/regional system dynamics
 - Persons – age, die
 - Household – form, grow, dissolve
 - Business – expand, contract
 - Developers – evaluate sites, build projects
 - Market – pricing, demand & supply
 - Special population – prisons, dorms, visitors
 - Infrastructure – schools, libraries, etc.



AZ-SMART \ OPUS MODEL TYPES

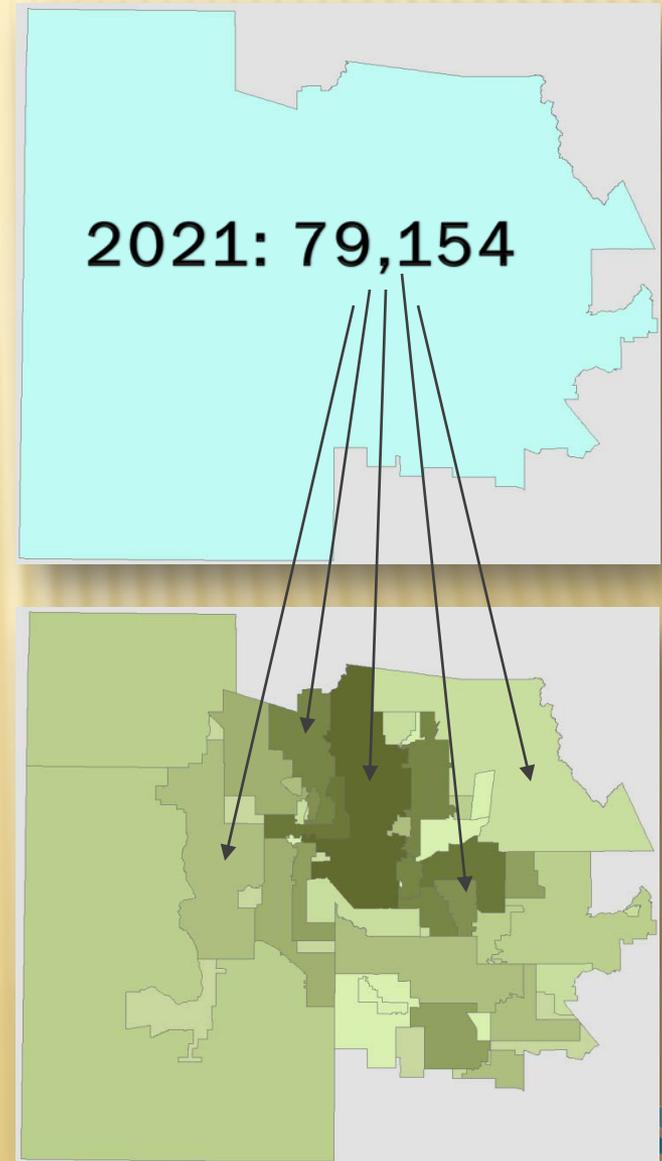
- ❑ **“Simple” model:**
 - ❑ Can be thought of as a simple calculation
 - ❑ Newly developed in OPUS for AZ-SMART
- ❑ **Allocation model:**
 - ❑ Allocates a given total of ‘X’ to dataset ‘Y’ based on weights in ‘Y’
 - ❑ Newly developed in OPUS for AZ-SMART
- ❑ **Regression model:**
 - ❑ Can be used to predict any continuous variable in a dataset during the simulation
- ❑ **Choice model:**
 - ❑ Discrete choice, binary (2 choice) or multinomial logit (2+ choices)



ALLOCATION MODEL EXAMPLE

HOTEL VISITOR MODEL

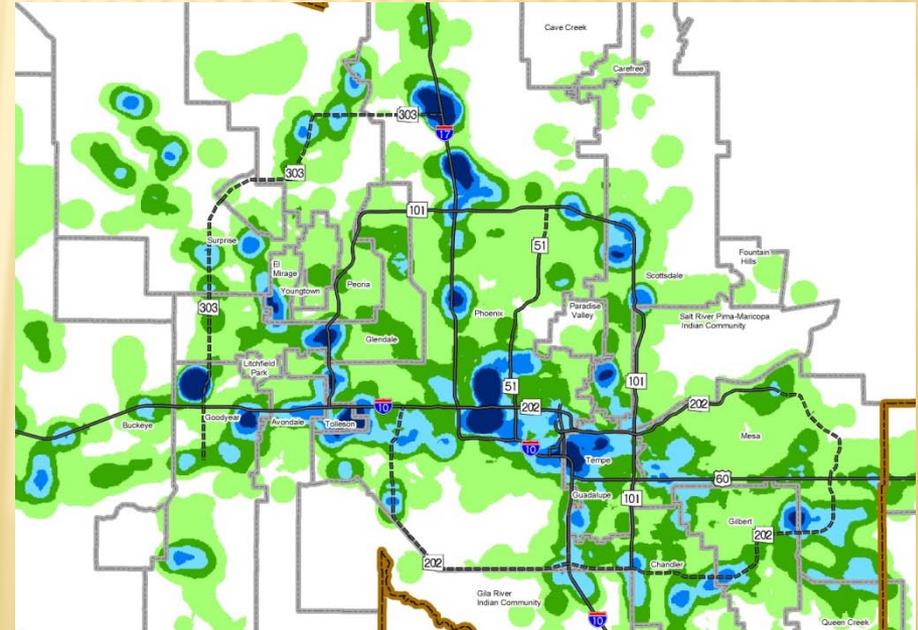
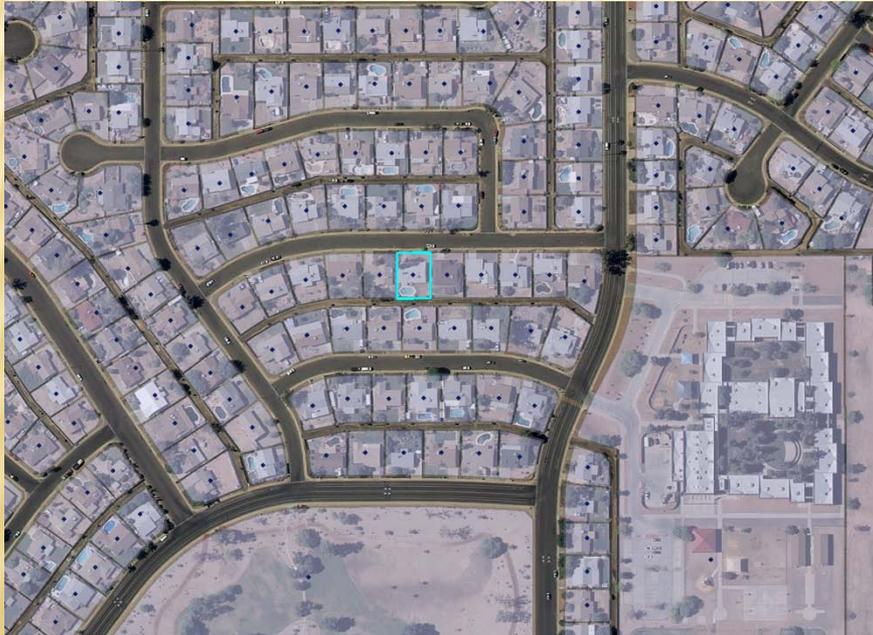
- Data inputs:
 - forecast of total hotel visitors for every year of the forecast period,
 - number of hotel rooms and occupancy rates by city
- Proportionally allocate the total number of hotel visitors to each City based on the number of hotel rooms and occupancy rates
- Constrain the allocation based on the capacity



REGRESSION MODEL EXAMPLE

REAL ESTATE PRICE MODEL

- Given independent variables and coefficients
- Calculate the price of all SFR homes for year 'X'
- $\text{unit_price} = (\text{coeff})\text{travel_time_to_CBD} + (\text{coeff})\text{house_sqft} + (\text{coeff})\text{density_of_service_jobs_within_35min_travel_time}$



CHOICE MODEL EXAMPLE

HOUSEHOLD LOCATION CHOICE MODEL

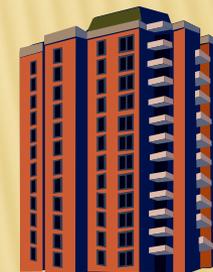
Household characteristics



Preferences / Needs



Location choice



□ $utility = avg_price(coeff) + dist_to_highway(coeff) + size\ of\ unit\ (coeff)$



AZ-SMART

DATA REQUIREMENTS



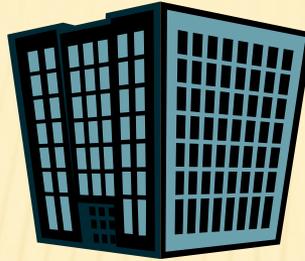
PRIMARY DATABASES

INPUTS AND OUTPUTS - PHYSICAL ENVIRONMENT

Parcels / Zones



Built space



Constraints



Development Projects



Unique ID Field	Parcel id/ Zone id	Building id	Constraint id	Proposal id, Template id
Location Links	Zones, tract, cities, zip code, etc.	Parcel id / Zone id	Parcel id / Zone id	Parcel id / Zone id
Data Source	Census boundaries, Assessors parcels, etc.	Assessors data	City/ Town General Plan, Slopes, Flood plains, env. sensitive areas, etc.	Known development projects from City/Town



PRIMARY DATABASES

INPUTS AND OUTPUTS - AGENTS

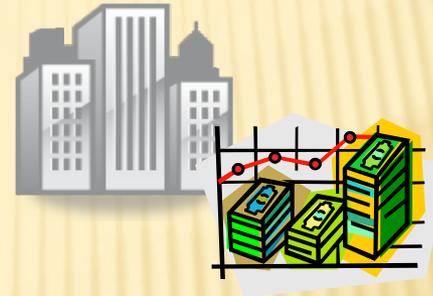
Households



Persons



Businesses



Jobs



Unique ID Field	Household id	Person id	Business id	Job id
Location Links	Building id	Household id	Building id	Business id
Data Source	Synthesized from Decennial Census, American Community Survey (ACS), Public Use Microdata Samples (PUMS)		Synthesized from Employment data base from Quarterly Census of Employment and Wages (QCEW) / other proprietary sources	

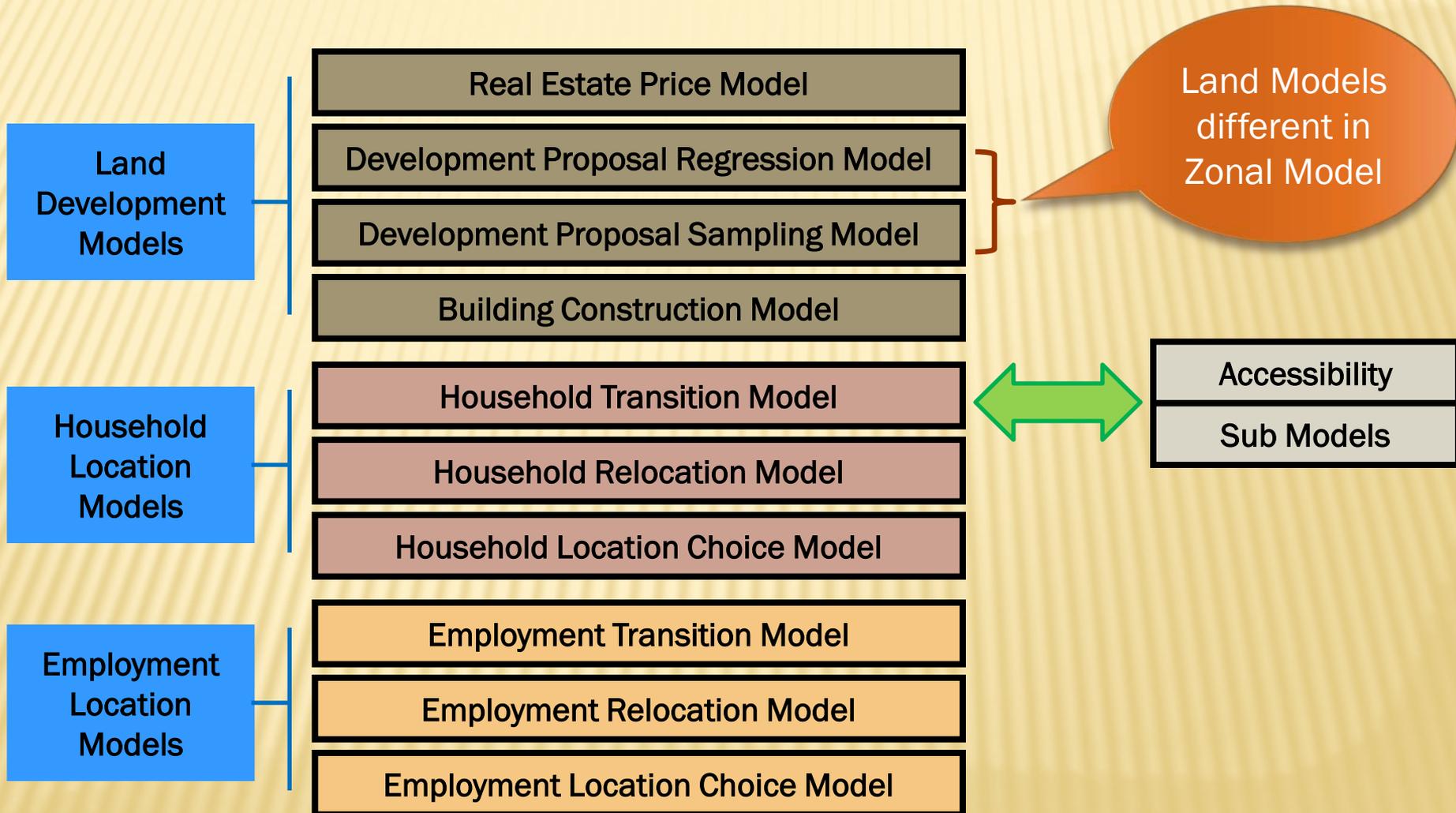


AZ-SMART

MODEL SEQUENCE

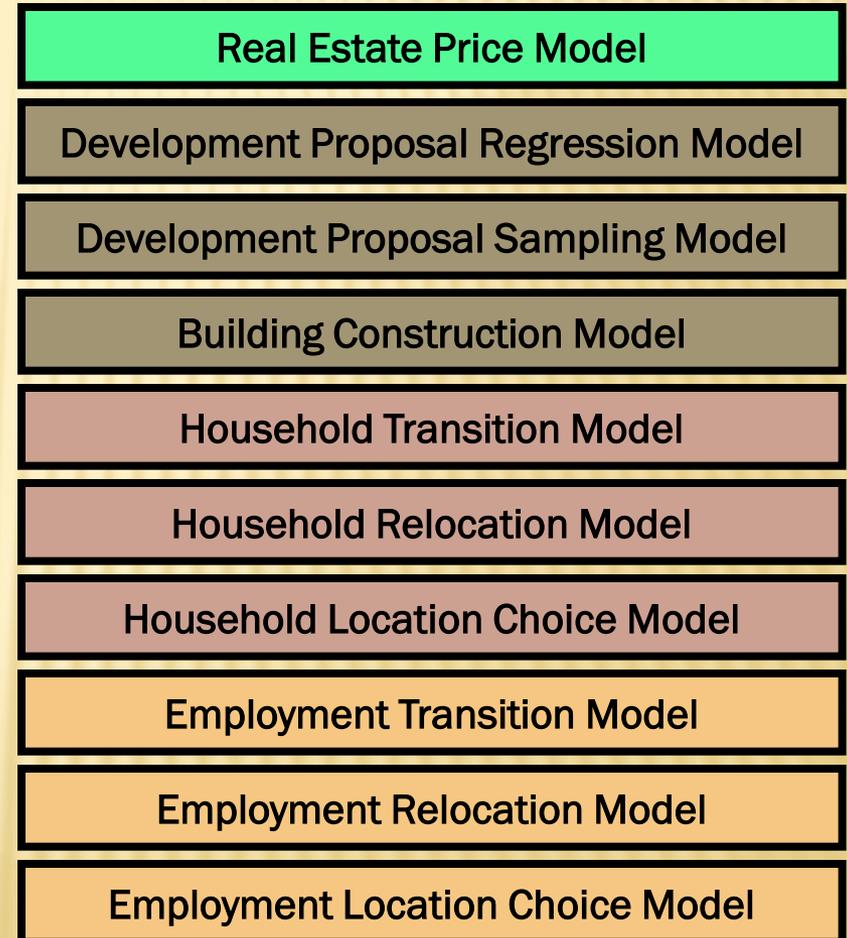


AZ-SMART PARCEL MODEL SEQUENCE



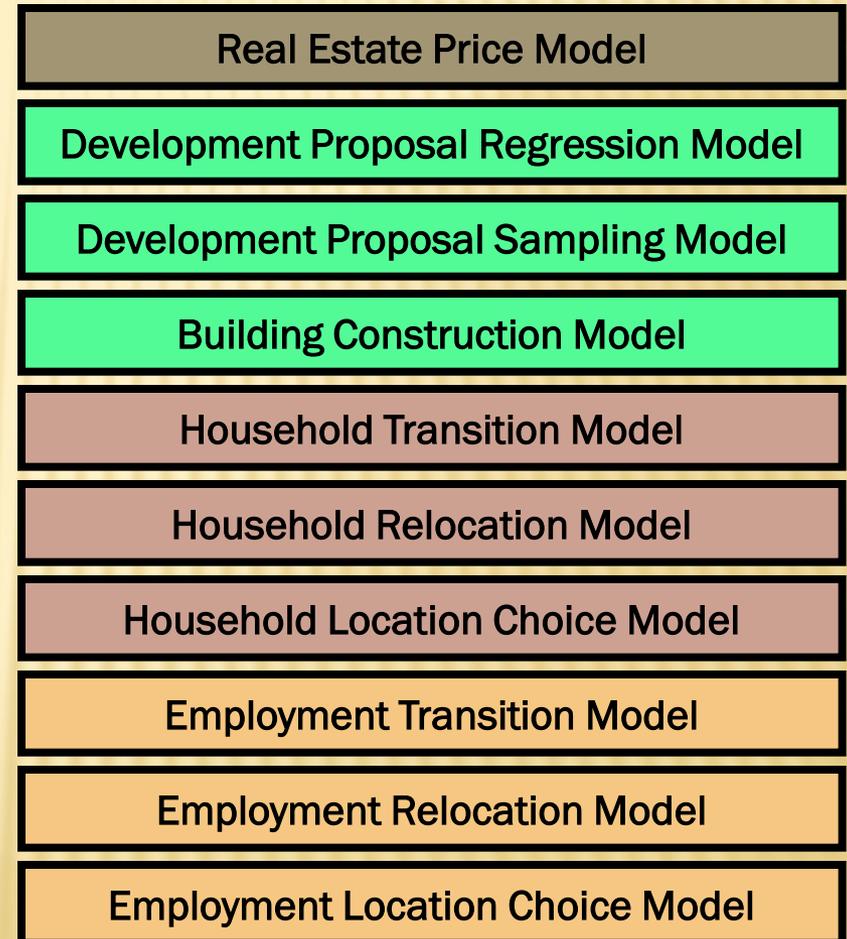
AZ-SMART REAL ESTATE PRICE MODEL

- ❑ Regression model
- ❑ Predicts price for “existing” development for simulation year
- ❑ Specification typically includes:
 - ❑ Location effects
 - ❑ Accessibility
 - ❑ Density effects
- ❑ Provides the inputs for the Real Estate Development Models



AZ-SMART REAL ESTATE DEVELOPMENT MODEL

- ❑ 3 separate models - each model depends upon the outputs of the last
- ❑ Development proposals and expected sale price for parcels conforming with constraints
- ❑ Choose projects based on return on investment and demand
- ❑ Construct buildings on selected proposals according the relevant velocity function



AZ-SMART REAL ESTATE DEVELOPMENT MODEL

Zonal Model – differences

- ❑ Samples developments from history table to be placed until target vacancy rates are satisfied
- ❑ Proposal location choice models:
 - ❑ independent variables influence the location choice of development
 - ❑ Agents to be located are developments
 - ❑ Location choice set is zones
- ❑ Construct buildings on selected proposals

Real Estate Price Model

Development Proposal Sampling Model

Development Proposal Location Choice

Building Construction Model

Household Transition Model

Household Relocation Model

Household Location Choice Model

Employment Transition Model

Employment Relocation Model

Employment Location Choice Model



HOUSEHOLD AND EMPLOYMENT MODELS

- ❑ **Adds and removes households and jobs based on control totals**
 - ❑ Flexible control total geography
 - ❑ Move households and jobs within region
- ❑ **Locates households and jobs in vacant space**
 - ❑ Specific built space in parcel model
 - ❑ Specific zones in zonal model
- ❑ **Stratified models as needed**
 - ❑ HH by size, income, tenure
 - ❑ Jobs by 2 digit NAICS
- ❑ **Specifications typically include:**
 - ❑ Distances/accessibility to amenities (parks, employment, transportation)
 - ❑ Density effects (population, housing, industry concentration), etc.

Real Estate Price Model

Development Proposal Regression Model

Development Proposal Sampling Model

Building Construction Model

Household Transition Model

Household Relocation Model

Household Location Choice Model

Employment Transition Model

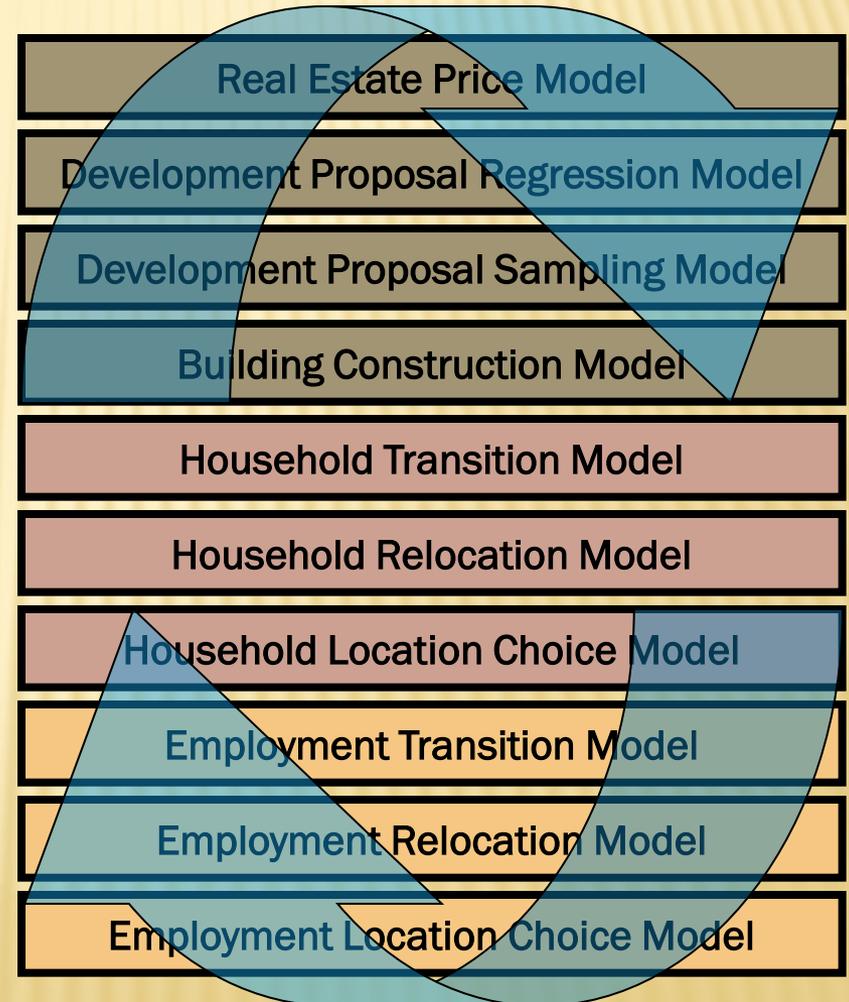
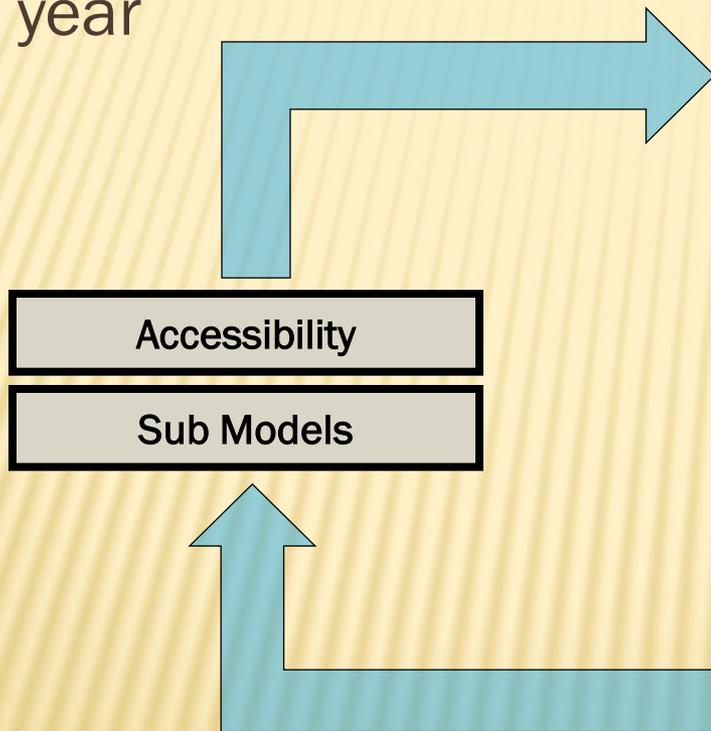
Employment Relocation Model

Employment Location Choice Model



REPEAT MODEL SEQUENCE

- ❑ Models repeat for every year
- ❑ Run external models every Nth year



AZ-SMART

CURRENT STATUS



JULY 2008 - PRESENT

- ❑ Phased implementation of AZ-SMART
 - ❑ Starting from simple – working towards end-state models
 - ❑ Model implementation hand in hand with data development work
 - ❑ V1 - Polygon based data (pseudo-parcels)
 - ❑ Land use types matching with SAM-IM
 - ❑ Simple model estimations
 - ❑ V2 – Detailed parcel level data for part of County
 - ❑ Redefined building types, constraints, etc.
 - ❑ Population and jobs synthesis
 - ❑ Disaggregated models (3 HH and 14 job categories)
- ❑ Tools for
 - ❑ Synthesis and matching to parcels
 - ❑ Data development and maintenance
- ❑ Systems Architecture
- ❑ Constant interaction with OPUS team and COG/MPO Users
- ❑ Identify future improvements

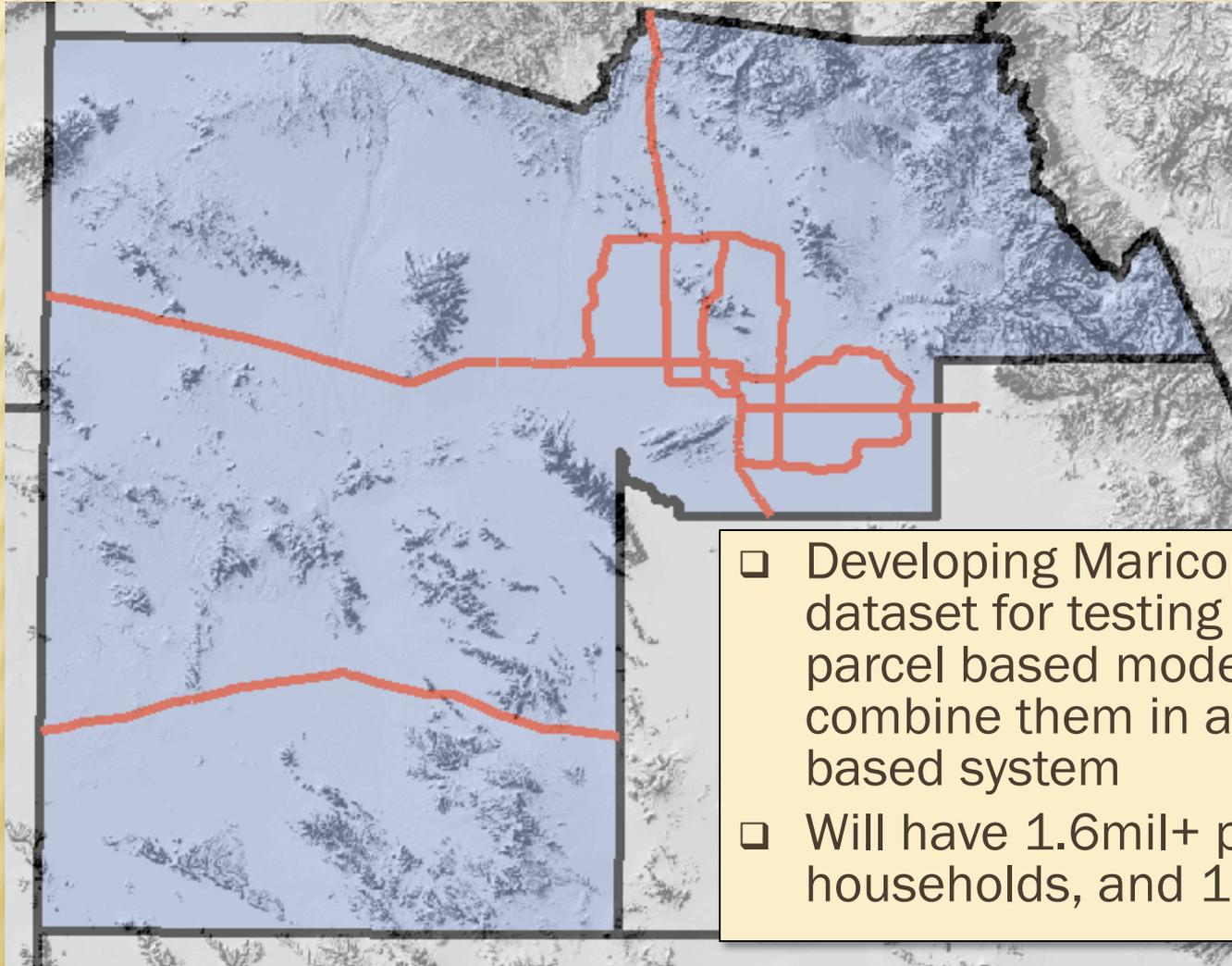


AZ-SMART CURRENT STATUS APRIL 2010

- ❑ 2 test datasets covering 3 SE Valley cities
- ❑ Both parcel and zone based model systems estimated and running, base year 2008 simulating to 2030
- ❑ Roughly 195k parcels, 168k households, 100k jobs



AZ-SMART COMING SOON



- ❑ Developing Maricopa County wide dataset for testing with zone and parcel based model systems, and to combine them in a 2 step subarea based system
- ❑ Will have 1.6mil+ parcels, 1.4mil+ households, and 1.7mil+ jobs

2012 PROJECTIONS

- ❑ Built on the AZ-SMART platform
- ❑ Complete datasets matching with Census 2010
 - ❑ Parcels
 - ❑ Built space
 - ❑ HH and Persons
 - ❑ Jobs and Businesses
- ❑ Development constraints and Known development projects – aligned with parcels
- ❑ Other datasets for all sub models
- ❑ Possible Model system enhancements
 - ❑ Household, neighborhood, business evolution
 - ❑ Parcel aggregation/disaggregation
- ❑ Model estimation by household and job type
- ❑ Testing and evaluation of results
- ❑ Final system ready for 2012 Projections



QUESTIONS?

Anubhav Bagley
abagley@mag.maricopa.gov

Rita Walton
rwalton@mag.maricopa.gov

(602) 254-6300

